GE Medical Systems

Technical Publications

Direction DOC2778755
Revision 1

3DXR
DICOM CONFORMANCE STATEMENT

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GE Medical Systems

REVISION HISTORY

REV	DATE	REASON FOR CHANGE
1	October 2022	Initial release of 3DXR 2.1

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1. CONFORMANCE STATEMENT OVERVIEW

3DXR is a tool that is installed on the same hardware platform as the base application, **Advantage Workstation**. This base application is a Networked Medical Imaging Console dedicated to Examination Review and Diagnosis. The workstation uses DICOM services to import acquisition images for possible further analysis or processing, and to export images and radiotherapy data to other vendors.

3DXR does not have an intrinsic DICOM Network feature. It does not directly invoke the DICOM Server AE.

Table 0.1 provides an overview of the SOP Classes supported by 3DXR.

Table 0.1 – SUPPORTED SOP CLASSES

SOP Classes	Parsed Input	Generated Output
Transfer		
X-Ray Image Storage	Yes	No
CT Image Storage	No	Yes

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2. INTRODUCTION

2.1 OVERVIEW

This DICOM Conformance Statement is divided into Sections as described below:

Section 2 (Introduction), which describes the overall structure, intent, and references for this Conformance Statement

Section 3 (Network Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 4 (X-Ray Image Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a X-Ray Image Information Object.

Section 5 (3D XACT Model Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a **3D XACT Model Object**.

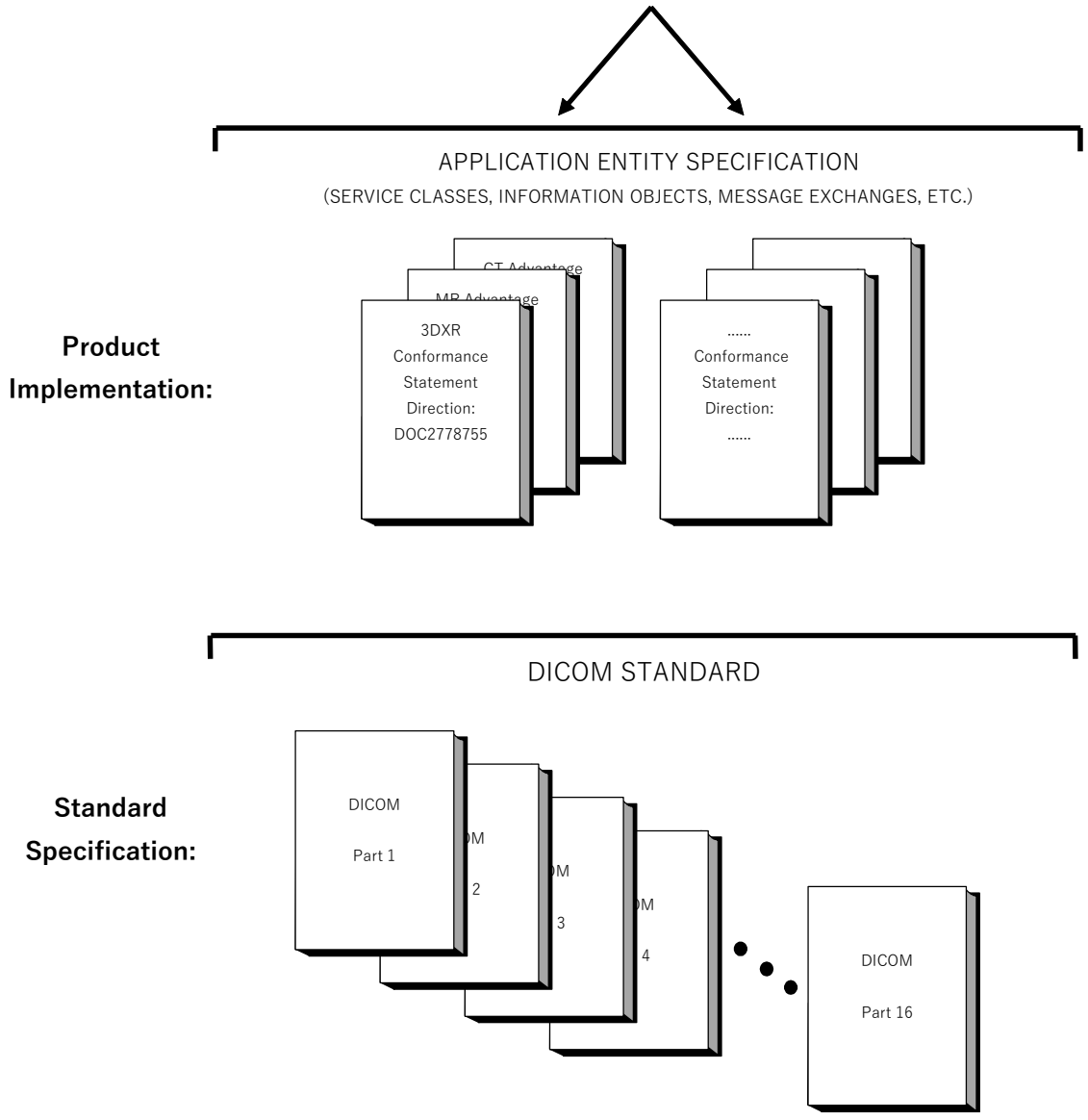
2.2. OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEMS DICOM Conformance Statements is shown in the Illustration below.

GEMS DICOM Conformance Statements

@

http://www.ge.com/DICOM



This document specifies the DICOM implementation. It is entitled:

3DXR
Conformance Statement for DICOM
Direction DOC2778755

This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required to interoperate with the GEMS network interface.

The GEMS Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM Part 8 standard.

For more information regarding DICOM, copies of the Standard may be obtained on the Internet at http://medical.nema.org. Comments on the Standard may be addressed to:

DICOM Secretariat
NEMA
1300 N. 17th Street, Suite 900
Arlington, VA 22209
USA
Phone: +1.703.841.3200

2.3. INTENDED AUDIENCE

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM Standard and with the terminology and concepts which are used in that Standard.

2.4. SCOPE AND FIELD OF APPLICATION

It is the intent of this document to provide an unambiguous specification for GEMS implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical data exchanged using DICOM. The GEMS Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEMS devices can use different Information Object Definitions. For example, a GEMS CT Scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this DICOM Conformance Statement are the Module Definitions, which define all data elements, used by this GEMS implementation. If the user encounters unspecified private data elements while parsing a GEMS Data Set, the user is well advised to ignore those data elements (per the DICOM standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all the private data elements, which are sent by GEMS devices.

2.5. IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non- GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE systems is

the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.

- **Validation** - Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications.

  Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non- GE device, as well as when images acquired on non- GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices, which have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) described by these DICOM Conformance Statements**. The **user** should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failures to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

- **Interaction** - It is the sole responsibility of the **non–GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

2.6. REFERENCES

NEMA PS3	Digital Imaging and Communications in Medicine (DICOM) Standard, available free at http://medical.nema.org/

2.7. DEFINITIONS

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class and Computed Radiography Image Storage SOP Class.

Application Entity (AE) – an end point of a DICOM information exchange, including the DICOM network or media interface software, i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title – the externally known name of an *Application Entity*, used to identify a DICOM application to other DICOM applications on the network.

Application Context – the specification of the type of communication used between *Application Entities*. Example: DICOM network protocol.

Association – a network communication channel set up between *Application Entities*.

Attribute – – a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD) – the specified set of *Attributes* that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The *Attributes* may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Joint Photographic Experts Group (JPEG) – a set of standardized image compression techniques, available for use by DICOM applications.

Media Application Profile – the specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

Module – a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation – first phase of *Association* establishment that allows *Application Entities* to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context – the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

Protocol Data Unit (PDU) – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Security Profile – a set of mechanisms, such as encryption, user authentication, or digital signatures, used by an *Application Entity* to ensure confidentiality, integrity, and/or availability of exchanged DICOM data

Service Class Provider (SCP) – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (Modality Worklist SCP).

Service Class User (SCU) – role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of

DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance – an information object; a specific occurrence of information exchanged in a *SOP Class*. Examples: a specific x-ray image.

Tag – a 32-bit identifier for a data element, represented as a pair of four-digit hexadecimal numbers, the "group" and the "element". If the "group" number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax – the encoding used for exchange of DICOM information objects and messages. Examples: *JPEG* compressed (images), little-endian explicit value representation.

Unique Identifier (UID) – a globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR) – the format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

2.8. SYMBOLS AND ABBREVIATIONS

AE	Application Entity
DICOM	Digital Imaging and Communications in Medicine
IOD	Information Object Definition
ISO	International Organization for Standards
LUT	Look-up Table
O	Optional (Key Attribute)
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
R	Required (Key Attribute)
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
VR	Value Representation
XA	X-ray Angiography

3. NETWORK CONFORMANCE STATEMENT

3.1. INTRODUCTION

This section of the DICOM Conformance Statement specifies the 3DXR compliance to DICOM requirements for Networking features.

3DXR is a tool that is installed on the same hardware platform as the base application, **Advantage Workstation**. This base application is a Networked Medical Imaging Console dedicated to Examination Review and Diagnosis. The workstation uses DICOM services to import acquisition images for possible further analysis or processing, and to export images and radiotherapy data to other vendors.

3DXR does not have an intrinsic DICOM Network feature. It does not directly invoke the DICOM Server AE. For some detailed information on DICOM features of Advantage Windows, refer to the respective Conformance Statement - *Advantage Workstation where 3DXR application is running*.

The application parses the following DICOM objects:

SOP Class Name	SOP Class UID
X-Ray Image Storage	1.2.840.10008.5.1.4.1.1.12.1

3DXR application parses 3D sequences acquired using 3D, 3D CT and 3D CT HD protocols.

The application creates the following DICOM objects:

SOP Class Name	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2

SOP Class “CT Image Storage” is used to create 3D XACT output, which is a CT Image Storage DICOM object extended with private elements as described in Section 5, 3D XACT MODEL information OBJECT IMPLEMENTATION.

3.2. IMPLEMENTATION MODEL

3.2.1 APPLICATION DATA FLOW DIAGRAM

Refer to the respective Conformance Statement - ***Advantage Workstation*** *where 3DXR application is running.*

3.2.2 PRESENTATION CONTEXT TABLE

Refer to the respective Conformance Statement - ***Advantage Workstation*** *where 3DXR application is running.*

3.2.3 REAL-WORLD ACTIVITIES

The user should select X-Ray image (XA) acquired with 3D/3D CT, 3DCT/3DCT HD, 3DStent or 3D Sub protocol, then start application from AW application. Start the reconstruction algorithm by pressing ‘Start’. After user request the 3D Model SOP Instance is created and saved into Advantage Windows database.

The **goal of this document** is to give a detailed description of:

the 3D MODEL DICOM IOD

Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

3.2.4 SOP INSTANCE UID, SERIES INSTANCE UID

Implementation UID assigned to 3DXR is: **1.2.840.113619.6.205**

An UID generated by a product has 2 parts : <root>.<suffix>.

For a GE product root is 1.2.840.113619 where

1 identifies ISO

2 identifies the ISO member body branch

840 identifies the country code

113619 identifies GEMS as a specific organization.

For a Series, Instances created in GE suffix is 2.Imp.id
where

Imp identifies a specific implementation and is registered within GE

id is a number or a substring (i.j or i.j.l...) defined by the implementation. In our implementation it means get UID from Advantage Windows (Conformance Statement - ***Advantage Workstation*** *Conformance Statement for DICOM.)*

So 3DXR will generate UIDs for instances that looks like: **1.2.840.113619.2.205**

3.2.5 SUPPORT OF EXTENDED CHARACTER SETS

3DXR application can process the Extended Char Set ISO_IR 100 (Latin alphabet Number 1 supplementary set), ISO_IR 192 (UTF-8) and GB18030 (Chinese).

The product user interface will display Extended Char Set ISO_IR 100, ISO_IR 192 or GB18030 character set.

3DXR can reconstructed 3D Acquisition with the Extended Char Set ISO_IR 100 (Latin alphabet Number 1 supplementary set), ISO_IR 192 (UTF-8) or GB18030 (Chinese).

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4 X-RAY ANGIOGRAPHY (XA) INFORMATION OBJECT IMPLEMENTATION

4.1. INTRODUCTION

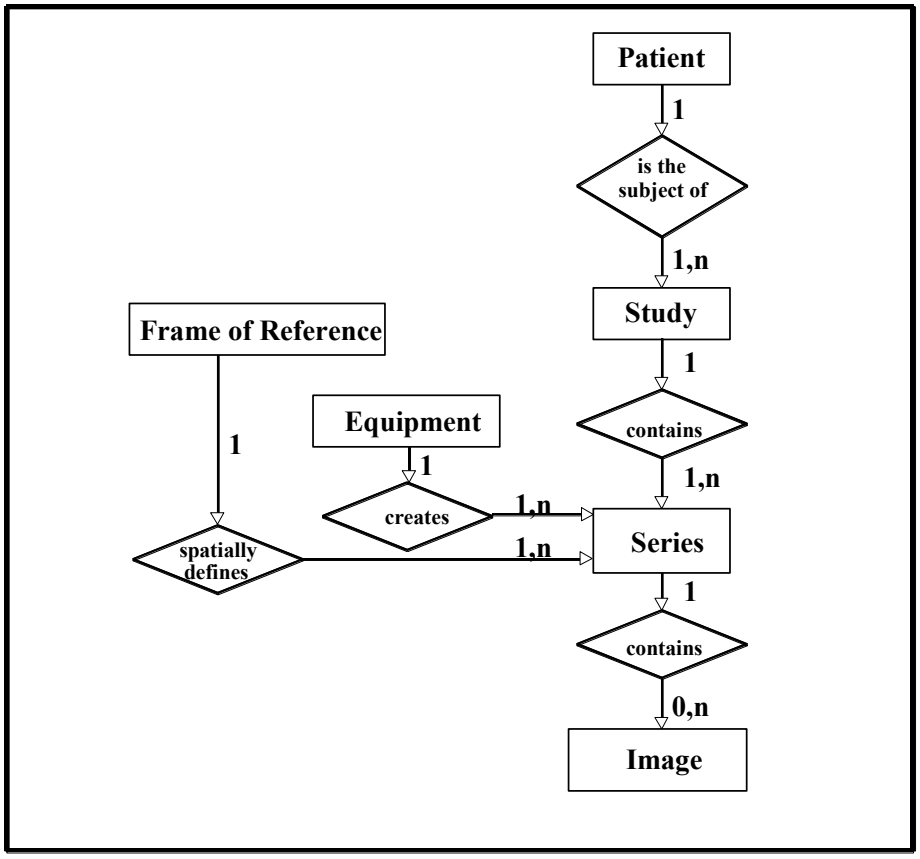
This section specifies the requirements for the DICOM X-Ray Image IOD when being used as input to 3DXR

4.2. X-RAY IMAGE IOD IMPLEMENTATION

This section defines how X-Ray Image attributes are used within the implementation, and whether these attributes are mandatory or optional for the correct operation of 3DXR

4.3. X-RAY IMAGE IOD ENTITY-RELATIONSHIP MODEL

ILLUSTRATION 4-1
X-RAY IMAGE ENTITY RELATIONSHIP DIAGRAM



The Entity-Relationship diagram for the X-Ray Image interoperability schema is shown in ILLUSTRATION 3-1. In this figure, the following diagrammatic convention is established to represent the information organization:

each entity is represented by a rectangular box

each relationship is represented by a diamond shaped box.

the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. See DICOM Part 3 Section 5.1.2 for an explanation of the entity-relationship notation.

4.4. ENTITIES DESCRIPTION

Refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the X-Ray Image information object.

4.5. 3DXR MAPPING OF DICOM ENTITIES

DICOM entities map to the 3DXR entities in the following manner:

TABLE 4-1
3DXR MAPPING OF DICOM ENTITIES

DICOM	3DXR
Patient Entity	Patient Entity (Advantage Workstation)
Study Entity	Exam Entity (Advantage Workstation)
Series Entity	Series Entity (Advantage Workstation)
Equipment Entity	Equipment Entity (Advantage Workstation)
Image Entity	Image Entity (Advantage Workstation)

4.6. IOD MODULE TABLE

The X-Ray Information Object Definitions comprise the modules of the following tables, plus Standard Extended and Private attributes. Which attributes will be described in the following section

TABLE 4-2
XA IMAGE IOD MODULES

Entity Name	Module Name	Usage	Comments	Reference
Patient	Patient	Mandatory	Required	4.7.2.1
Study	General Study	Mandatory	Required	4.7.3.1
	Patient Study	User Option	Used if present	4.7.3.2
Series	General Series	Mandatory	Required	4.7.4.1
	Frame of Reference	User Option	Used if present	4.7.4.2
Equipment	General Equipment	Mandatory	Required	4.7.5.1
Image	General Image	Mandatory	Required	4.7.6.1
	Image Pixel	Mandatory	Required	4.7.6.2
	Contrast/Bolus	C - Required if contrast media was used in this Image	Used if present	4.7.6.3
	Multi-frame	C - Required if pixel data is Multi-Frame Cine data	Required	4.7.6.4
	X-Ray Image	Mandatory	Required	4.7.6.5

	X-Ray Acquisition	Mandatory	Required	4.7.6.6
	X-Ray Table	C - Required if Image is created with table motion	Used if present	4.7.6.7
	XA Positioner	Mandatory	Required	4.7.6.8
	X-Ray Collimator	Mandatory	Required	4.7.6.9
	SOP Common	Mandatory	Required	4.7.6.10
	Cine	C - Required if pixel data is Multi-Frame Cine data	Used if present	4.7.6.11
	X-Ray Filtration	Mandatory	Required	4.7.6.12

4.7. INFORMATION MODULE DEFINITIONS

Please refer to DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the XA Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

4.7.1 COMMON INFORMATION MODULE DEFINITIONS

Please refer to DICOM Part 3 (Information Object Definitions) for a description of each of the entities, modules, and attributes contained within the XA Information Objects.

4.7.2 PATIENT ENTITY

4.7.2.1 PATIENT MODULE

TABLE 4-3
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Required with any value
Patient ID	(0010,0020)	2	Required with any value
Patient's Birth Date	(0010,0030)	2	Required with any value (including no value, zero length data element)
Patient's Sex	(0010,0040)	2	Required with any value (including no value, zero length data element)
Issuer of Patient ID	(0010,0021)	2	Copied to derived instances without change
Other Patient Ids Sequence	(0010,1002)	2	Copied to derived instances without change
>Patient ID	(0010,0020)	2	Copied to derived instances without change
>Issuer of Patient ID	(0010,0021)	2	Copied to derived instances without change
>Type of Patient ID	(0010,0022)	2	Copied to derived instances without change
Referenced Patient Sequence	(0008,1120)	3	Copied to derived instances without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied to derived instances without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied to derived instances without change

4.7.3 STUDY ENTITY

4.7.3.1. GENERAL STUDY MODULE

TABLE 4-4
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Required with any not null value
Study Date	(0008,0020)	2	Required with any value (including no value, zero length data element)
Study Time	(0008,0030)	2	Required with any value (including no value, zero length data element)
Referring Physician's Name	(0008,0090)	2	Required with any value (including no value, zero length data element)
Study ID	(0020,0010)	2	Required with any value (including no value, zero length data element)
Accession Number	(0008,0050)	2	Required with any value (including no value, zero length data element)
Study Description	(0008,1030)	3	Copied to derived instances without change
Procedure Code Sequence	(0008,1032)	3	Copied to derived instances without change
>Code Value	(0008,0100)	1C	Copied to derived instances without change
>Coding Scheme Designator	(0008,0102)	1C	Copied to derived instances without change
>Code Meaning	(0008,0104)	1	Copied to derived instances without change
Name of Physician(s) Reading Study	(0008,1060)	3	Copied to derived instances without change
Referenced Study Sequence	(0008,1110)	3	Copied to derived instances without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied to derived instances without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied to derived instances without change

4.7.3.2. PATIENT STUDY MODULE

TABLE 4-5
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Copied to derived instances without change
Patient's Size	(0010,1020)	3	Copied to derived instances without change
Patient's Weight	(0010,1030)	3	Copied to derived instances without change

4.7.4 SERIES ENTITY

4.7.4.1. GENERAL SERIES MODULE

TABLE 4-6
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Series Instance UID	(0020,000E)	1	Required with any not null value
Series Number	(0020,0011)	2	Required with any value (including no value, zero length data element)
Performing Physician’s Name	(0008,1050)	3	Copied to derived instances without change
Operators’ Name	(0008,1070)	3	Copied to derived instances without change
Protocol Name	(0018,1030)	3	Copied to derived instances without change

Attribute Name	Tag	Type	Attribute Description
Laterality	(0020,0060)	2C	Copied to derived instances without change
Request Attributes Sequence	(0040,0275)	3	Copied to derived instances without change
>Requested Procedure Description	(0032,1060)	3	Copied to derived instances without change
>Scheduled Procedure Step Description	(0040,0007)	3	Copied to derived instances without change
>Scheduled Protocol Code Sequence	(0040,0008)	3	Copied to derived instances without change
>>Code Value	(0008,0100)	1C	Copied to derived instances without change
>>Coding Scheme Designator	(0008,0102)	1C	Copied to derived instances without change
>>Code Meaning	(0008,0104)	1	Copied to derived instances without change
>Scheduled Procedure Step ID	(0040,0009)	1C	Copied to derived instances without change
>Requested Procedure ID	(0040,1001)	1C	Copied to derived instances without change

4.7.4.2. FRAME OF REFERENCE

TABLE 4-7
FRAME OF REFERENCE MODULE ATTRIBUTES (INPUT)

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	3	Not used

4.7.5 EQUIPMENT ENTITY

4.7.5.1. GENERAL EQUIPMENT MODULE

TABLE 4-8
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Required with any value (including no value, zero length data element)
Institution Name	(0008,0080)	3	Copied to derived instances without change
Institution Address	(0008,0081)	3	Copied to derived instances without change
Station Name	(0008,1010)	3	Copied to derived instances without change
Manufacturer Model Name	(0008,1090)	3	Copied to derived instances without change
Device Serial Number	(0018,1000)	3	Copied to derived instances without change
Software Versions	(0018,1020)	3	Copied to derived instances without change

4.7.6 IMAGE ENTITY

4.7.6.1. GENERAL IMAGE MODULE

TABLE 4-9
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	Required with any value (including no value, zero length data element)
Instance Comments	(0020,4000)	3	Copied to derived instances without change
Acquisition Date	(0008,0022)	3	Copied to derived instances without change
Acquisition Time	(0008,0032)	3	Copied to derived instances without change
Patient Orientation	(0020,0020)	2C	Not used

4.7.6.2. IMAGE PIXEL MODULE

TABLE 4-10
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Not used
Photometric Interpretation	(0028,0004)	1	Not used
Rows	(0028,0010)	1	Value shall be 500 to 1000
Columns	(0028,0011)	1	Value shall be 500 to 1000
Bits Allocated	(0028,0100)	1	Not used
Bits Stored	(0028,0101)	1	Value shall be 12
High Bit	(0028,0102)	1	Not used
Pixel Representation	(0028,0103)	1	Not used
Pixel Data	(7FE0,0010)	1	Required with any value

4.7.6.3. CONTRAST/BOLUS MODULE

TABLE 4-11
CONTRAST/BOLUS MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Contrast/Bolus Agent		(0018,0010)	LO	1	2	Copied to derived instances without change
Auto injection enabled	GEMS_DL_IMG_01	(0019,xxA4)	CS	1	3	Copied to derived instances without change
Injection phase	GEMS_DL_IMG_01	(0019,xxA5)	CS	1	3	Copied to derived instances without change
Injection delay	GEMS_DL_IMG_01	(0019,xxA6)	DS	1	3	Copied to derived instances without change
Reference injection frame number	GEMS_DL_IMG_01	(0019,xxA7)	IS	1	3	Copied to derived instances without change
Contrast/Bolus Start Time		(0018,1042)	TM	1	3	Copied to derived instances without change
Contrast/Bolus Stop Time		(0018,1043)	TM	1	3	Copied to derived instances without change
Contrast/Bolus Ingredient		(0018,1048)	CS	1	3	Copied to derived instances without change

4.7.6.4. MULTI-FRAME MODULE

TABLE 4-12
MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Value shall be higher than 0.9*((expected_number_of_frames)-2) Where expected_number_of_frames is stored in (0019,xxCA) The above check is only done if expected_number_of_frames is present.
Frame Increment Pointer	(0028,0009)	1	Not used

4.7.6.5. X-RAY IMAGE MODULE

TABLE 4-13
X-RAY IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Pixel Intensity Relationship	(0028,1040)	1	Value shall be “SQRT”

4.7.6.6. X-RAY ACQUISITION MODULE

TABLE 4-14
X-RAY ACQUISITION MODULE

Attribute Name	Tag	Type	Attribute Description
KVP	(0018,0060)	2	Not used
FOV Shape	(0018,1147)	3	Copied to derived instances without change
FOV Dimension	(0018,1149)	3	Copied to derived instances without change
Intensifier Size	(0018,1162)	3	Copied to derived instances without change
Imager Pixel Spacing	(0018,1164)	3	The first value shall be higher than 0
Grid	(0018,1166)	3	Value shall be one of the following "IN" "NONE" If the value does not match, the application assumes that the attribute is not present
Focal Spot	(0018,1190)	3	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Exposure Time	(0018,1150)	2C	Copied to derived instances without change
Xray Tube Current	(0018,1151)	2C	Copied to derived instances without change
Exposure in MicroAs	(0018,1152)	2C	Copied to derived instances without change

4.7.6.7. X-RAY TABLE MODULE

TABLE 4-15
X-RAY TABLE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Table Motion	(0018,1134)	2	Required with any value (including no value, zero length data element)
Table Vertical Increment	(0018,1135)	2C	Copied to derived instances without change
Table Lateral Increment	(0018,1136)	2C	Copied to derived instances without change
Table Longitudinal Increment	(0018,1137)	2C	Copied to derived instances without change
Table Angle	(0018,1138)	3	Copied to derived instances without change

4.7.6.8. XA POSITIONER MODULE

TABLE 4-16
XA POSITIONER MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Positioner Primary Angle	(0018,1510)	2	Required with any value (including no value, zero length data element)
Positioner Secondary Angle	(0018,1511)	2	Required with any value (including no value, zero length data element)

Attribute Name	Tag	Type	Attribute Description
Distance Source to Detector	(0018,1110)	3	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Distance Source to Patient	(0018,1111)	3	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Positioner Motion	(0018,1500)	2C	Copied to derived instances without change
Positioner Primary Angle Increment	(0018,1520)	2C	Copied to derived instances without change
Positioner Secondary Angle Increment	(0018,1521)	2C	Copied to derived instances without change

4.7.6.9. X-RAY COLLIMATOR MODULE

TABLE 4-17
X-RAY COLLIMATOR MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Collimator left vertical edge	(0018,1702)	1C	Value shall be 1 to 1000. If the value does not match, the application assumes that the attribute is not present
Collimator right vertical edge	(0018,1704)	1C	Value shall be 1 to 1000. If the value does not match, the application assumes that the attribute is not present
Collimator up horizontal edge	(0018,1706)	1C	Value shall be 1 to 1000. If the value does not match, the application assumes that the attribute is not present
Collimator low horizontal edge	(0018,1708)	1C	Value shall be 1 to 1000. If the value does not match, the application assumes that the attribute is not present

4.7.6.10. SOP COMMON MODULE

TABLE 4-18
SOP COMMON MODULE ATTRIBUTES (INPUT)

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Required with any not null value.
SOP Instance UID	(0008,0018)	1	Required with any not null value.
Specific Character Set	(0008,0005)	1C	Copied to derived instances without change

4.7.6.11. CINE MODULE

TABLE 4-19
CINE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Time Vector	(0018,1065)	1C	Copied to derived instances without change
Frame Delay	(0018,1066)	3	Copied to derived instances without change

4.7.6.12. X-RAY FILTRATION MODULE

TABLE 4-20
X-RAY FILTRATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Contour Filter Type	(0018,1160)	3	Copied to derived instances without change

4.7.7 PRIVATE DATA ATTRIBUTES

4.7.7.1. PRIVATE GROUP DLX_SERIE_01

Private Group DLX_SERIE_01 is modeled as part of the Image (X-Ray Acquisition, X-Ray Table, X-Ray Positioner, Spatial Filters) Information Entity.

TABLE 4-21
PRIVATE GROUP DLX_SERIE_01 (INPUT)

Attribute Name	Tag	VR	VM	Attribute Description and Use
Angle value 1	(0019,xx01)	DS	1	Copied to derived instances without change
Angle value 2	(0019,xx02)	DS	1	Copied to derived instances without change
Angle value 3	(0019,xx03)	DS	1	Copied to derived instances without change
IP Address	(0019,xx20)	LO	1	Copied to derived instances without change
Table Vertical Position	(0019,xx21)	DS	1	Copied to derived instances without change
Table Longitudinal Position	(0019,xx22)	DS	1	Copied to derived instances without change
Table Lateral Position	(0019,xx23)	DS	1	Copied to derived instances without change

4.7.7.2. PRIVATE GROUP GEMS_DL_IMG_01

Private Group GEMS_DL_IMG_01 is modeled as part of the Image (X-Ray Acquisition, X-Ray Positioner, General image, Contrast Bolus, Cine, Xray Table, Xray 3D Acquisition, Spectral Filters) Information Entity.

TABLE 4-22
PRIVATE GROUP GEMS_DL_IMG_01

Attribute Name	Tag	VR	VM	Attribute Description and Use
Patient Position Per Image	(0019,xxC7)	CS	1	Value shall be one of the following "HFS" "HFP" "HFDR" "HFDL" "FFS" "FFP" "FFDR" "FFDL" If the value does not match, the application assumes that the attribute is not present
Acquisition plane	(0019,xxDE)	CS	1	"MONOPLANE" "MONOPLANE FRT" "MONOPLANE LAT" "BIPLANE FRT". If the value does not match, the application assumes that the attribute is not present
FOV Dimension Double	(0019,xx0B)	DS	1-2	Value shall be higher than 0
Image Flip	(0019,xx95)	CS	2	Horizontal flip of the image at acquisition, followed by vertical flip Value shall be one of the following "NO\NO" "YES\NO" "NO\YES" "YES\YES" If the value does not match, the application assumes that the attribute is not present
EPT	(0019,xxA9)	DS	1-N	Value shall be higher or equal to 0 If the value does not match, the application assumes that the attribute is not present
kVp Actual Vector	(0019,xxAF)	DS	1-N	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
mAs Actual Vector	(0019,xxB0)	DS	1-N	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Acquisition Protocol User Name	(0019,xxB3)	LO	1	Required with any value (including no value, zero length data element)
Preselected Pivot Rotation Speed	(0019,xxC5)	FL	1	Value shall be one of the following "10" “16” "20" “28é "40" If the value does not match, the application assumes that the attribute is not present
ABD Vector	(0019,xxB9)	FL	1-N	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Acquisition SUB mode	(0019,xxBB)	CS	1	Copied to derived instances without change
Table cradle tilt angle	(0019,xxBC)	FL	1	Copied to derived instances without change
3D structure of interest	(0019,xxC8)	CS	1	Value shall be one of the following "VASCULAR" "OTHER" If the value does not match, the application assumes that the attribute is not present

Attribute Name	Tag	VR	VM	Attribute Description and Use
3D Calibration Out of Date Flag	(0019,xxC9)	CS	1	Value shall be one of the following "YES" "NO" If the value does not match, the application assumes that the attribute is not present
Angle 1 Increment	(0019,xx97)	DS	1-N	Copied to derived instances without change
Angle 2 Increment	(0019,xx98)	DS	1-N	Copied to derived instances without change
Angle 3 Increment	(0019,xx99)	DS	1-N	Copied to derived instances without change
Auto Injection Enabled	(0019,xxA4)	CS	1	Copied to derived instances without change
Injection Phase	(0019,xxA5)	CS	1	Copied to derived instances without change
Injection Delay	(0019,xxA6)	DS	1	Copied to derived instances without change
Reference Injection Frame Number	(0019,xxA7)	IS	1	Copied to derived instances without change
Pw Actual Vector	(0019,xxC2)	DS	1-N	Copied to derived instances without change
Spectral Filter Thickness	(0019,xxC4)	IS	1	Value shall be one of the following "0" "100" "200" "300" "600" "900" If the value does not match, the application assumes that the attribute is not present
Preselected Pivot Rotation Speed	(0019,xxC5)	FL	1	Value shall be one of the following “10” “16” “20” “28” “40” If the value does not match, the application assumes that the attribute is not present.
Acquisition Region Detail	(0019,xxC6)	CS	1	Copied to derived instances without change
3Dspin expected number of frames	(0019,xxCA)	IS	1	Copied to derived instances without change
Detection gain value	(0019,xxD4)	FL	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
mR mAs calibration value	(0019,xxD5)	FL	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Table X Position to Isocenter increment	(0019,xxD7)	FL	1-N	Copied to derived instances without change
Table Y Position to Isocenter increment	(0019,xxD8)	FL	1-N	Copied to derived instances without change

Attribute Name	Tag	VR	VM	Attribute Description and Use
Table Z Position to Isocenter vector increment	(0019,xxD9)	FL	1-N	Copied to derived instances without change
Table Head Tilt Angle increment	(0019,xxDA)	FL	1-N	Copied to derived instances without change
Table Cradle Angle increment	(0019,xxDB)	FL	1-N	Copied to derived instances without change
Table rotation angle	(0019,xxEA)	FL	1	Copied to derived instances without change
Table X Position to Isocenter	(0019,xxEB)	FL	1	Copied to derived instances without change
Table Y Position to Isocenter	(0019,xxEC)	FL	1	Copied to derived instances without change
Table Z Position to Isocenter	(0019,xxED)	FL	1	Copied to derived instances without change
Table head tilt angle	(0019,xxEE)	FL	1	Copied to derived instances without change
Table Top Vertical Position to Rirp Equipment	(0019,xx67)	DS	1	Copied to derived instances without change
Table Top Longitudinal Position to Rirp Equipment	(0019,xx68)	DS	1	Copied to derived instances without change
Table Top Lateral Position to Rirp Equipment	(0019,xx69)	DS	1	Copied to derived instances without change
ISO X versus RIRP	(0019,xx7A)	DS	1	Copied to derived instances without change
ISO Y versus RIRP	(0019,xx7B)	DS	1	Copied to derived instances without change
ISO Z versus RIRP	(0019,xx7C)	DS	1	Copied to derived instances without change
3D Imaging Purpose	(0019,xxFC)	LO	1	Copied to derived instances without change

4.7.7.3. PRIVATE GROUP GEMS_XR3DCAL_01

TABLE 4-23

PRIVATE GROUP GEMS_XR3DCAL_01

Attribute Name	Tag	VR	VM	Attribute Description and Use

3Dcal image rows	(0021,xx01)	IS	1	Value shall be higher than 0
3Dcal image columns	(0021,xx02)	IS	1	Value shall be higher than 0
3Dcal acquisition date	(0021,xx04)	DA	1	Copied to derived instances without change
3Dcal acquisition time	(0021,xx05)	TM	1	Copied to derived instances without change
3Dcal Pivot angle vector	(0021,xx09)	FL	1-N	Not mandatory
3Dcal matrix sequence	(0021,xx0B)	SQ	1	Sequence shall exist
>3Dcal matrix elements	(0021,xx0C)	LO	1-N	Shall contains value
3Dcal 3D frame unit size	(0021,xx0E)	FL	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
3Dcal image frame origin row	(0021,xx10)	FL	1	Not mandatory
3Dcal image frame origin column	(0021,xx11)	FL	1	Not mandatory
3Dcal number of images	(0021,xx13)	IS	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
3Dcal image pixel spacing	(0021,xx15)	FL	2	Value shall be higher than 0
3Dcal centering mode	(0021,xx16)	CS	1	Value shall be "RECTIFICATION"

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5. 3D XACT MODEL INFORMATION OBJECT IMPLEMENTATION

5.1. INTRODUCTION

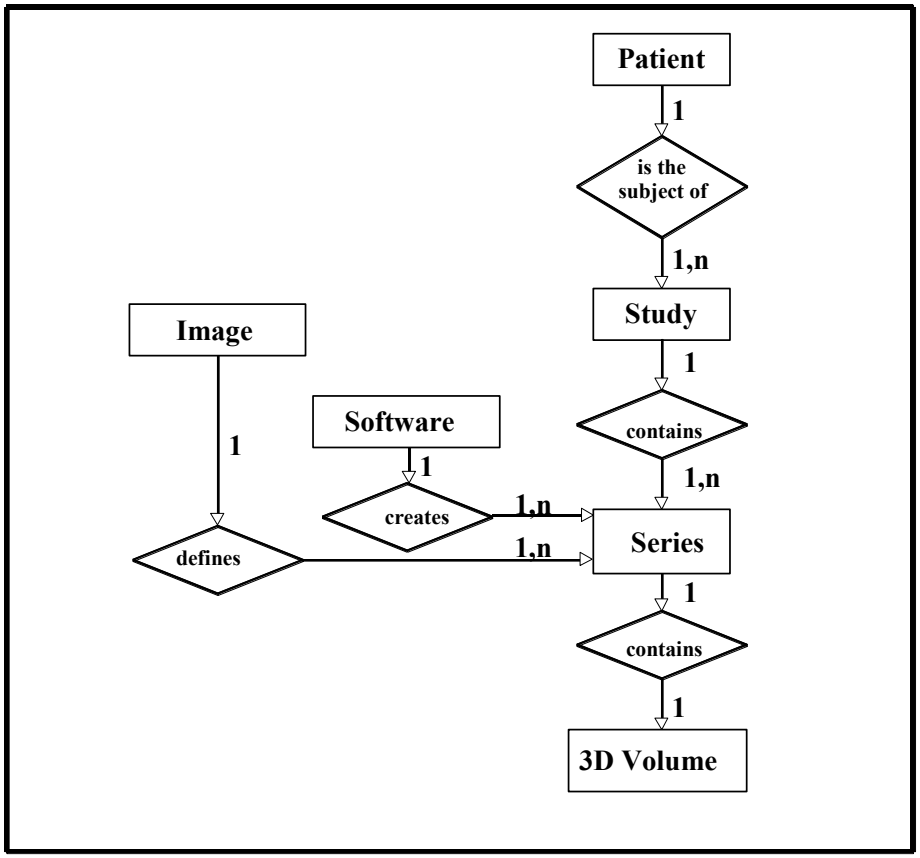
This section specifies the requirements for the DICOM 3D XACT Model IOD as output of the 3DXR product. 3D XACT Model is an CT Image Storage.

5.2. 3D XACT MODEL IOD IMPLEMENTATION

This section defines how 3D XACT Model attributes are used within the implementation.

5.3. 3D XACT MODEL ENTITY-RELATIONSHIP MODEL

ILLUSTRATION 5-1
3D XACT MODEL ENTITY RELATIONSHIP DIAGRAM



The Entity-Relationship diagram for the 3D XACT Model interoperability schema is shown in ILLUSTRATION 5-1. In this figure, the following diagrammatic convention is established to represent the information organization:

each entity is represented by a rectangular box

each relationship is represented by a diamond shaped box.

the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. See DICOM Part 3 Section 5.1.2 for an explanation of the entity-relationship notation.

5.4. ENTITIES DESCRIPTION

Refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the 3D XACT Model Image information object.

5.5. 3DXR MAPPING OF DICOM ENTITIES

DICOM entities map to the 3DXR entities in the following manner:

TABLE 5-1
3DXR MAPPING OF DICOM ENTITIES

DICOM	3DXR
Patient Entity	Patient Entity (Advantage Workstation)
Study Entity	Exam Entity (Advantage Workstation)
Series Entity	Series Entity (Advantage Workstation)
Equipment Entity	Equipment Entity (Advantage Workstation)
Image Entity	Image Entity (Advantage Workstation)

5.6. IOD MODULE TABLE

The 3D XACT Model Information Object Definitions comprise the modules of the following tables, plus Standard Extended and Private attributes.

TABLE 5-2
XA IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Mandatory	5.6.2.1
Study	General Study	Mandatory	5.6.3.1
	Patient Study	User Option	5.6.3.2
Series	General Series	Mandatory	5.6.4.1
	Frame Of Reference	User Option	5.6.4.2
Equipment	General Equipment	Mandatory	5.6.5.1
Image	General Image	Mandatory	5.6.6.1
	Image Plane	Mandatory	5.6.6.2
	Image Pixel	Mandatory	5.6.6.3
	Contrast Bolus	Module is not present if no contrast injection in original image	5.6.6.4
	VOI LUT	User Option	5.6.6.5
	SOP Common	Mandatory	5.6.6.6
	CT Image	Mandatory	5.6.6.7
	X-Ray 3D Angiographic Image Contributing Sources*	User Option	5.6.6.8
	X-Ray 3D Angiographic Acquisition*	User Option	5.6.6.9
	X-Ray 3D Reconstruction*	User Option	5.6.6.10
	Image – Equipment Coordinate Relationship	Mandatory	5.6.6.11

* These modules contain both Standard Extended and Private attributes.

Please refer to DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the 3D XACT Model Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

5.6.1 COMMON INFORMATION MODULE DEFINITIONS

Please refer to DICOM Part 3 (Information Object Definitions) for a description of each of the entities, modules, and attributes contained within the 3D XACT Model Information Objects.

5.6.2 PATIENT ENTITY

5.6.2.1. PATIENT MODULE

TABLE 5-3
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Copied from XA image without change
Patient ID	(0010,0020)	2	Copied from XA image without change
Patient's Birth Date	(0010,0030)	2	Copied from XA image without change
Patient's Sex	(0010,0040)	2	Copied from XA image without change
Referenced Patient Sequence	(0008,1120)	3	Sequence is copied from XA image without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied from XA image without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied from XA image without change
Other Patient Ids Sequence	(0010, 1002)	2	Sequence is copied from XA image without change
>patient id	(0010, 0020)	2	Copied from XA image without change
>Issuer of Patient ID	(0010, 0021)	2	Copied from XA image without change
> type of Patient ID	(0010,0021)	2	Copied from XA image without change

5.6.3 STUDY ENTITY

5.6.3.1. GENERAL STUDY MODULE

TABLE 5-4
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008,0020)	2	Copied from XA image without change
Study Time	(0008,0030)	2	Copied from XA image without change
Accession Number	(0008,0050)	2	Copied from XA image without change
Referring Physician's Name	(0008,0090)	2	Copied from XA image without change
Study Description	(0008,1030)	3	Copied from XA image without change
Procedure Code Sequence	(0008,1032)	3	Copied from XA image without change

>Code Value	(0008,0100)	1C	Copied from XA image without change
>Coding Scheme Designator	(0008,0102)	1C	Copied from XA image without change
>Code Meaning	(0008,0104)	1	Copied from XA image without change
Name of Physician(s) Reading Study	(0008,1060)	3	Copied from XA image without change
Study Instance UID	(0020,000D)	1	Copied from XA image without change
Study ID	(0020,0010)	2	Copied from XA image without change
Referenced Study Sequence	(0008,1110)	3	Copied from XA image without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied from XA image without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied from XA image without change

5.6.3.2. PATIENT STUDY MODULE

TABLE 5-5
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Copied from XA image without change
Patient's Size	(0010,1020)	3	Copied from XA image without change
Patient's Weight	(0010,1030)	3	Copied from XA image without change

5.6.4 SERIES ENTITY

5.6.4.1. GENERAL SERIES MODULE

TABLE 5-6
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Series Date		(0008,0021)	DA	1	3	Date of the creation of the object
Series Time		(0008,0031)	TM	1	3	Time of the creation of the object
Modality		(0008,0060)	CS	1	1	"XA"
Source Modality	GEMS_3D_XA_01	(0031,xx07)	CS	1	1	"XA"
Series Description		(0008,103E)	LO	1	3	Describe the series, and contains references for the source image to help identification in Advantage Windows Browser
Performing Physician's Name		(0008,1050)	PN	1-N	3	Copied from XA image without change
Operators' Name		(0008,1070)	PN	1-N	3	Copied from XA image without change
Protocol Name		(0018,1030)	LO	1	3	"3D/3D CT NOSUB" or "3D CT/3D CT HD NOSUB"
Patient Position		(0018,5100)	CS	1	2C	Copy from original image: tag (0019,xxC7)
Series Instance UID		(0020,000E)	UI	1	1	Application generated unique ID
Series Number		(0020,0011)	IS	1	2	Copy from original image: tag (0020,0013)
Laterality		(0020,0060)	CS	1	2C	Copied from XA image without change
Smallest Pixel Value in Series		(0028,0108)	SS	1	3	Calculated by the application.
Largest Pixel Value in Series		(0028,0109)	SS	1	3	Calculated by the application.
Request Attributes Sequence		(0040,0275)	SQ	1	3	Copied from XA image without change
>Requested Procedure Description		(0032,1060)	LO	1	3	Copied from XA image without change
>Scheduled Procedure Step Description		(0040,0007)	LO	1	3	Copied from XA image without change
>Scheduled Protocol Code Sequence		(0040,0008)	SQ	1	3	Copied from XA image without change
>>Code Value		(0008,0100)	SH	1	1C	Copied from XA image without change
>>Coding Scheme Designator		(0008,0102)	SH	1	1C	Copied from XA image without change
>>Code Meaning		(0008,0104)	LO	1	1	Copied from XA image without change
>Scheduled Procedure Step ID		(0040,0009)	SH	1	1C	Copied from XA image without change
>Requested Procedure ID		(0040,1001)	SH	1	1C	Copied from XA image without change

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Related Series Sequence		(0008,1250)	SQ	1	3	Contains one item for each volume generated simultaneously with this volume.
>Study Instance UID		(0020,000D)	UI	1	1	Contains the Study UID of the additional volume, it's the same for all the volumes
>Series Instance UID		(0020,000E)	UI	1	1	For each item, it contains the Series UID of the additional volume
>Purpose of Reference Code Sequence		(0040,A170)	SQ	1-N	3	One item only
>>Code Value		(0008,0100)	SH	1	1C	"INNOVA-050" for a mask volume item "INNOVA-051" for a contrast volume item "INNOVA-052" for a subtracted volume item
>>Coding Scheme Designator		(0008,0102)	SH	1	1C	“99GEMS”
>>Code Meaning		(0008,0104)	LO	1	1	Value can be: "3D Mask Series Simultaneously Reconstructed" "3D Contrast Series Simultaneously Reconstructed" "3D Subtracted Series Simultaneously Reconstructed"

5.6.4.2. FRAME OF REFERENCE MODULE

TABLE 5-7
FRAME OF REFERENCE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Application generated unique ID
Position Reference Indicator	(0020,1040)	2	""

5.6.5 EQUIPMENT ENTITY

5.6.5.1. GENERAL EQUIPMENT MODULE

TABLE 5-8
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	"GE MEDICAL SYSTEMS"
Institution Name	(0008,0080)	3	Copied from XA image without change
Institution Address	(0008,0081)	3	Copied from XA image without change
Station Name	(0008,1010)	3	Station Name of the Advantage Windows
Manufacturer’s Model Name	(0008,1090)	3	Model Name of the Advantage Windows
Device Serial Number	(0018,1000)	3	Serial Number of the Advantage Windows
Software Version(s)	(0018,1020)	3	Version of the 3DXR application
Date of Last Calibration	(0018,1200)	3	Copy from original image: tag (0021,xx04)

Time of Last Calibration	(0018,1201)	3	Copy from original image: tag (0021,xx05)

5.6.6 PRIVATE IMAGE ENTITY

5.6.6.1. GENERAL IMAGE MODULE

TABLE 5-9
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Content Date	(0008,0023)	2C	Date of the creation of the object
Content Time	(0008,0033)	2C	Date of the creation of the object
Source Image Sequence	(0008,2112)	1	Contains 1 item
>Referenced SOP Class UID	(0008,1150)	1	Copy from original image: tag (0008,0016)
>Referenced SOP Instance UID	(0008,1155)	1	Copy from original image: tag (0008,0018)
Instance Number	(0020,0013)	2	Zero-based number of current slice
Image Comments	(0020,4000)	3	"Slice " + <zero-based number of current slice>
Acquisition Date	(0008,0022)	3	Copied from XA image without change
Acquisition Time	(0008,0032)	3	Copied from XA image without change
Derivation Description	(0008,2111)	3	"3D Reconstruction from Rotational 2D Projection Xray Angiograpy"
Images in Acquisition	(0020,1002)	3	Computed from algorithm output
Burned In Annotations	(0028,0301)	3	"NO"
Lossy Image Compression	(0028,2110)	3	"00"
Image type	(0008,0008)	1	Refer to CT Image module, 5.6.6.7

5.6.6.2. IMAGE PLANE MODULE

TABLE 5-10
IMAGE PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Computed from algorithm output
Image Orientation (Patient)	(0020,0037)	1	Calculated by the application based on XA image tag (0019,xxC7) /(0019,xxEA)/(0019,xxEE)/(0019,xxBC), private creator "GEMS_DL_IMG_01"
Image Position (Patient)	(0020,0032)	1	Calculated by the application based on XA image tag (0019,xxC7) /(0019,xxEA)/(0019,xxEE)/(0019,xxBC), private creator "GEMS_DL_IMG_01"
Slice Thickness	(0018,0050)	2	Computed from algorithm output
Slice Location	(0020,1041)	3	Computed from algorithm output

5.6.6.3. IMAGE PIXEL MODULE

TABLE 5-11
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Rows	(0028,0010)	1	Computed from algorithm output
Columns	(0028,0011)	1	Computed from algorithm output

Attribute Name	Tag	Type	Attribute Description
Pixel representation	(0028,0103)	1	"1"
Smallest Image Pixel Value	(0028,0106)	3	Computed from algorithm output
Largest Image Pixel Value	(0028,0107)	3	Computed from algorithm output
Pixel Data	(7FE0,0010)	1	Pixel data of the current slice
Samples per pixel	(0028,0002)	1	Refer to CT Image module, 5.6.6.7
Photometric interpretation	(0028,0004)	1	Refer to CT Image module, 5.6.6.7
Bits allocated	(0028,0100)	1	Refer to CT Image module, 5.6.6.7
Bits stored	(0028,0101)	1	Refer to CT Image module, 5.6.6.7
High bit	(0028,0102)	1	Refer to CT Image module, 5.6.6.7

5.6.6.4. CONTRAST BOLUS MODULE

TABLE 5-12
CONTRAST BOLUS MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Contrast/Bolus Agent		(0018,0010)	LO	1	2	If there was a contrast injection in original image, copied from XA image without change. Otherwise not present.
Auto injection enabled	GEMS_DL_IMG_01	(0019,xxA4)	CS	1	3	“YES” if there was a contrast injection in original image. Otherwise not present.
Injection phase	GEMS_DL_IMG_01	(0019,xxA5)	CS	1	3	Copied from XA image without change
Injection delay	GEMS_DL_IMG_01	(0019,xxA6)	DS	1	3	Copied from XA image without change
Reference injection frame number	GEMS_DL_IMG_01	(0019,xxA7)	IS	1	3	Copied from XA image without change
Contrast/Bolus Start Time		(0018,1042)	TM	1	3	Copied from XA image without change
Contrast/Bolus Stop Time		(0018,1043)	TM	1	3	Copied from XA image without change
Contrast/Bolus Ingredient		(0018,1048)	CS	1	3	Copied from XA image without change

5.6.6.5. VOI LUT MODULE

TABLE 5-13
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Window center	(0028,1050)	1C	“350”
Window width	(0028,1051)	1C	“2000”

5.6.6.6. SOP COMMON MODULE

TABLE 5-14
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Specific character	(0008,0005)	1C	Copied from XA image without change
SOP class UID	(0008,0016)	1	"1.2.840.10008.5.1.4.1.1.2"
SOP instance UID	(0008,0018)	1	Application generated unique ID

5.6.6.7. CT IMAGE MODULE

TABLE 5-15
CT IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image type	(0008,0008)	1	"DERIVED\SECONDARY\AXIAL\3DANGIO"
Samples per pixel	(0028,0002)	1	"1"
Photometric interpretation	(0028,0004)	1	"MONOCHROME2"
Bits allocated	(0028,0100)	1	"16"
Bits stored	(0028,0101)	1	"16"
High bit	(0028,0102)	1	"15"
Rescale Intercept	(0028,1052)	1	"-1000"
Rescale Slope	(0028,1053)	1	"1"
Rescale Type	(0028,1054)	3	"US"
KVP	(0018,0060)	2	""
Acquisition Number	(0020,0012)	2	Copy from original image: tag (0020,0013)

5.6.6.8. X-RAY 3D ANGIOGRAPHIC IMAGE CONTRIBUTING SOURCES MODULE

TABLE 5-16
X-RAY 3D ANGIOGRAPHIC IMAGE CONTRIBUTING SOURCES MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Contributing Sources Sequence		(0018,9506)	SQ	1	3	Contains 1 item
>Contributing SOP Instances Reference Sequence		(0020,9529)	SQ	1	3	Copied if present in the original image
>>Study Instance UID		(0020,000D)	UI	1	3	Copied from XA image without change
>>Referenced Series Sequence		(0008,1115)	SQ	1	3	Copied from XA image without change
>>>Series Instance UID		(0020,000E)	UI	1	3	Copied from XA image without change
>>>Series Number		(0020,0011)	IS	1	3	Copied from XA image without change
>>>Referenced Instance Sequence		(0008,114A)	SQ	1	3	Copied from XA image without change
>>>>Referenced SOP Class UID		(0008,1150)	UI	1	3	Copied from XA image without change
>>>>Referenced SOP Instance UID		(0008,1155)	UI	1	3	Copied from XA image without change
>>>>Instance Number		(0020,0013)	IS	1	3	Copied from XA image without change
>Manufacturer		(0008,0070)	LO	1	3	Copy from original image: tag (0008,0070)

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Manufacturer's Model Name		(0008,1090)	LO	1	3	Copied if present in the original image: tag (0008,1090)
>Device Serial Number		(0018,1000)	LO	1	3	Copied if present in the original image: tag (0018,1000)
>Software Versions		(0018,1020)	LO	1-N	3	Copied if present in the original image: tag (0018,1020)
>Acquisition Datetime		(0008,002A)	DT	1	3	Copied if present in the original image Acquisition date (0008,0022) and time (0008,0032) in format "YYYYMMDDHHMMSS"
>Acquisition Date		(0008,0022)	DA	1	3	Copy from original image: tag (0008,0022)
>Acquisition Time		(0008,0032)	TM	1	3	Copy from original image: tag (0008,0032)
>Station Name		(0008,1010)	SH	1	3	Copied if present in the original image: tag (0008,1010)
>Operators' Name		(0008,1070)	PN	1-N	3	Copied if present in the original image: tag (0008,1070)
>Protocol Name		(0018,1030)	LO	1	3	Copied if present in the original image: tag (0018,1030)
>Acquisition Protocol Name		(0018,9423)	LO	1	3	Copied if present in the original image: tag (0019,xxB3)
>Rows		(0028,0010)	US	1	3	Copy from original image: tag (0028,0010)
>Columns		(0028,0011)	US	1	3	Copy from original image: tag (0028,0011)
>Bits Stored		(0028,0101)	US	1	3	Copy from original image: tag (0028,0101)
>Plane Identification		(0018,9457)	CS	1	3	Copied if present in the original image "MONOPLANE", "PLANE A" or "PLANE B"
>Imager Pixel Spacing		(0018,1164)	DS	2	3	Copied if present in the original image: tag (0018,1164)
>Ip address	DLX_SERIE_01	(0019,xx20)	LO	1	3	Copy from original image: tag (0019,xx20)

5.6.6.9. X-RAY 3D ANGIOGRAPHIC ACQUISITION MODULE

TABLE 5-17
X-RAY ANGIOGRAPHIC ACQUISITION MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
X-Ray 3D Acquisition Sequence		(0018,9507)	SQ	1	3	Contains 1 item
>Field of View Shape		(0018,1147)	CS	1	3	Copied if present in the original image
>X-Ray Receptor Type		(0018,9420)	CS	1	3	Copied if present in the original image
>Frame Time Vector		(0018,1065)	DS	1-N	3	Copied from XA image without change
>Frame Delay		(0018,1066)	DS	1	3	Copied from XA image without change
>kVp actual vector	GEMS_DL_IMG_01	(0019,xxAF)	DS	1-N	3	Copied from XA image without change
>mAs actual vector	GEMS_DL_IMG_01	(0019,xxB0)	DS	1-N	3	Copied from XA image without change
>pw actual vector	GEMS_DL_IMG_01	(0019,xxC2)	DS	1-N	3	Copied from XA image without change
>Contrast/Bolus Agent		(0018,0010)	LO	1	3	Copied if present in the original image
>Auto injection enabled	GEMS_DL_IMG_01	(0019,xxA4)	CS	1	3	Copied from XA image without change
>Injection phase	GEMS_DL_IMG_01	(0019,xxA5)	CS	1	3	Copied from XA image without change
>Injection delay	GEMS_DL_IMG_01	(0019,xxA6)	DS	1	3	Copied from XA image without change
>Reference injection frame number	GEMS_DL_IMG_01	(0019,xxA7)	IS	1	3	Copied from XA image without change
>Filter Material		(0018,7050)	CS	1-N	3	Copied if present in the original image
>Filter Thickness Minimum		(0018,7052)	DS	1-N	3	Copied if present in the original image: tag (0019,xxC4)
>Filter Thickness Maximum		(0018,7054)	DS	1-N	3	Copied if present in the original image: tag (0019,xxC4)
>Table Motion		(0018,1134)	CS	1	3	Copied from XA image without change
>Positioner Motion		(0018,1500)	CS	1	3	Copied from XA image without change
>Positioner Primary Angle		(0018,1510)	DS	1	3	Copied from XA image without change
>Positioner Secondary Angle		(0018,1511)	DS	1	3	Copied from XA image without change
>Positioner Primary Angle Increment		(0018,1520)	DS	1-N	3	Copied from XA image without change
>Positioner Secondary Angle Increment		(0018,1521)	DS	1-N	3	Copied from XA image without change
>Angle value 1	DLX_SERIE_01	(0019,xx01)	DS	1	3	Copied from XA image without change
>Angle value 2	DLX_SERIE_01	(0019,xx02)	DS	1	3	Copied from XA image without change

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Angle value 3	DLX_SERIE_01	(0019,xx03)	DS	1	3	Copied from XA image without change
>Angle 1 increment	GEMS_DL_IMG_01	(0019,xx97)	DS	1-N	3	Copied from XA image without change
>Angle 2 increment	GEMS_DL_IMG_01	(0019,xx98)	DS	1-N	3	Copied from XA image without change
>Angle 3 increment	GEMS_DL_IMG_01	(0019,xx99)	DS	1-N	3	Copied from XA image without change
>Field of View Dimension(s) in Float		(0018,9461)	FL	1-2	3	Copied if present in the original image: tag (0019,xx0B)
>Field of View Dimension(s)		(0018,1149)	IS	1-2	3	Copy from original image: tag (0018,1149)
>Grid		(0018,1166)	CS	1	3	Copied if present in the original image: tag (0018,1166)
>KVP		(0018,0060)	DS	1	3	Copied if present in the original image: tag (0018,0060)
>X-Ray Tube Current in mA		(0018,9330)	FD	1	3	Copied if present in the original image: tag (0018,1151)
>Exposure Time in ms		(0018,9328)	FD	1	3	Copied if present in the original image: tag (0018,1150)
>Exposure in mAs		(0018,9332)	FD	1	3	Copied if present in the original image: tag (0018,1152)
>Intensifier Size		(0018,1162)	DS	1	3	Copy from original image: tag (0018,1162)
>Distance Source to Detector		(0018,1110)	DS	1	3	Copied if present in the original image: tag (0018,1110)
>Distance Source to Isocenter		(0018,9402)	FL	1	3	Copied if present in the original image: tag (0018,1111)
>Focal Spot		(0018,1190)	DS	1	3	Copied if present in the original image: tag (0018,1190)
>Filter Type		(0018,1160)	SH	1	3	Copied if present in the original image: tag (0018,1160)
>Table Angle		(0018,1138)	DS	1	3	Copy from original image: tag (0018,1138)
>Table vertical position	DLX_SERIE_01	(0019,xx21)	DS	1	3	Copy from original image: tag (0019,xx21)
>Table longitudinal position	DLX_SERIE_01	(0019,xx22)	DS	1	3	Copy from original image: tag (0019,xx22)
>Table lateral position	DLX_SERIE_01	(0019,xx23)	DS	1	3	Copy from original image: tag (0019,xx23)
>table rotation angle	GEMS_DL_IMG_01	(0019,xxEA)	FL	1	3	Copy from original image: tag (0019,xxEA)

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>table head tilt angle	GEMS_DL_IMG_01	(0019,xxEE)	FL	1	3	Copy from original image: tag (0019,xxEE)
>table cradle angle	GEMS_DL_IMG_01	(0019,xxBC)	FL	1	3	Copy from original image: tag (0019,xxBC)
>Table Top Vertical Position to RIRP Equipment	GEMS_DL_IMG_01	(0019,xx67)	DS	1	3	Copy from original image: tag (0019,xx67)
>Table Top Longitudinal Position to RIRP Equipment	GEMS_DL_IMG_01	(0019,xx68)	DS	1	3	Copy from original image: tag (0019,xx68)
>Table Top Lateral Position to RIRP Equipment	GEMS_DL_IMG_01	(0019,xx69)	DS	1	3	Copy from original image: tag (0019,xx69)
>Table X Position to Isocenter	GEMS_DL_IMG_01	(0019,xxEB)	FL	1	3	Copy from original image: tag (0019,xxEB)
>Table Y Position to Isocenter	GEMS_DL_IMG_01	(0019,xxEC)	FL	1	3	Copy from original image: tag (0019,xxEC)
>Table Z Position to Isocenter	GEMS_DL_IMG_01	(0019,xxED)	FL	1	3	Copy from original image: tag (0019,xxED)
>ISO X versus RIRP	GEMS_DL_IMG_01	(0019,xx7A)	DS	1	3	Copy from original image: tag (0019,xx7A)
>ISO Y versus RIRP	GEMS_DL_IMG_01	(0019,xx7B)	DS	1	3	Copy from original image: tag (0019,xx7B)
>ISO Z versus RIRP	GEMS_DL_IMG_01	(0019,xx7C)	DS	1	3	Copy from original image: tag (0019,xx7C)
>Preselected pivot rotation speed	GEMS_DL_IMG_01	(0019,xxC5)	FL	1	3	Copy from original image: tag (0019,xxC5)
>3Dspin expected number of frames	GEMS_DL_IMG_01	(0019,xxCA)	IS	1	3	Copy from original image: tag (0019,xxCA)
>Acquisition Positioner Calibration Date	GEMS_3D_XA_01	(0031,xx09)	DA	1	3	Copy from original image: tag (0021,xx04)
>Acquisition Positioner Calibration Time	GEMS_3D_XA_01	(0031,xx0A)	TM	1	3	Copy from original image: tag (0021,xx05)
>Positioner Calibration Out of Date Status	GEMS_3D_XA_01	(0031,xx0B)	CS	1	3	Derived from XA image tag (0019,xxC9), private creator "GEMS_DL_IMG_01". "0" or "1"
>3D Imaging Purpose	GEMS_DL_IMG_01	(0019,xxFC)	LO	1	3	Copy from original image: tag (0019,xxFC)

5.6.6.10. X-RAY 3D RECONSTRUCTION MODULE

TABLE 5-18
X-RAY 3D RECONSTRUCTION MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
X-Ray 3D Reconstruction Sequence		(0018,9530)	SQ	1	3	Contains 1 item
>Reconstruction Description		(0018,9531)	LO	1	3	Reconstruction description based on user settings and input sequence parameters
>Application Name		(0018,9524)	LO	1	3	Name of the 3DXR application
>Application Version		(0018,9525)	LO	1	3	Version of the 3DXR application
>Application Manufacturer		(0018,9526)	LO	1	3	"GE MEDICAL SYSTEMS"
>Algorithm Type		(0018,9527)	CS	1	3	"FILTER_BACK_PROJ"
>Algorithm Description		(0018,9528)	LO	1	3	Output by the reconstruction algorithm
>Algorithm Version	GEMS_3D_XA_01	(0031,xx08)	LO	1	3	Output by the reconstruction algorithm
>Acquisition Index		(0020,9518)	US	1-N	3	"1"
>Structure Of Interest	GEMS_3D_XA_01	(0031,xx01)	CS	1	3	Copy from original image: tag (0019,xxC8)
>Missing Frames Status	GEMS_3D_XA_01	(0031,xx02)	CS	1	3	"0" or "1"
>Anatomy	GEMS_3D_XA_01	(0031,xx03)	CS	1	3	Copy from original image: tag (0019,xxC6)
>Volume Subtraction Mode	GEMS_3D_XA_01	(0031,xx04)	CS	1	3	"NOSUB"
>Reconstruction Flitering Selection	GEMS_3D_XA_01	(0031,xx05)	CS	1	3	"0" "1" "2" "3" "4"
>Volume Internal Upscan Method	GEMS_3D_XA_01	(0031,xx06)	CS	1	3	"0" "1"
>Spin Phase of Volume	GEMS_3D_XA_01	(0031,xx20)	CS	1	3	“MASK” or “CONTRAST”
>3D Scatter reduction	GEMS_3D_XA_01	(0031,xx22)	CS	1	3	"YES" or "NO"

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Metal Artifact Reduction	GEMS_3D_XA_01	(0031,xx23)	CS	1	3	"YES" or "NO"
>Subtracted Artifact Reduction	GEMS_3D_XA_01	(0031,xx24)	CS	1	3	"YES" or "NO"
>Extended Range	GEMS_3D_XA_01	(0031,xx25)	IS	1	3	"1" "2"
>Motion Artifact Reduction	GEMS_3D_XA_01	(0031,xx26)	CS	1	3	"YES" or "NO"
>Stent Orientation	GEMS_3D_XA_01	(0031,xx27)	DS	6	3	
Fiducial Sequence		(0070,031e)	SQ	1	3	
>Fiducial Identifier		(0070,0310)	SH	1	3	OT_ATM1.0
>Fiducial Description		(0070,030F)	ST	1	3	OmniTRAX Active Tracker Marker V1.0
>Shape Type		(0070,0306)	CS	1	3	SHAPE
>Number of Contour Points		(3006,0046)	IS	1	3	"0" "4"
>Contour Data		(3006,0050)	DS	1	3	p1x\p1y\p1z\p2x\p2y\p2z\p3x\p3y\p3z\p4x\p4y\p4z
>Contour Uncertainty Radius		(0070,0312)	FD	1	3	1.0

5.6.6.11. IMAGE – EQUIPMENT COORDINATE RELATIONSHIP

TABLE 5-19
IMAGE – EQUIPMENT COORDINATE RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image to Equipment Mapping Matrix	(0028,9520)	3	Calculated